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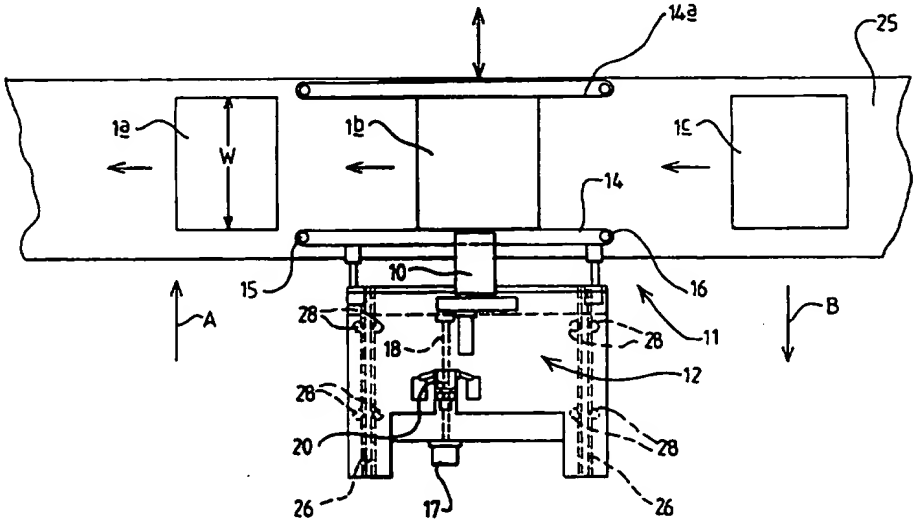
(54) Abstract Title
Method of printing on conveyed articles

(57) A method of aligning a work tool (10) relative to a succession of articles (1a,1b,1c) being conveyed, comprises providing the work tool (10) at a work station (11) on a carriage (12), which carriage (12) is moveable fore and aft (A,B) in a direction transverse to the conveying direction, the carriage (12) comprising a drive element (14) which is adapted to engage each of the articles (1a, 1b, 1c) when they are conveyed in succession to the work station (11) while a work operation is performed on each of the articles by the tool (10), the method being characterised in that the carriage (12) is movable transversely relative to the conveying direction or by a motive means (17,18,19) so that the position of the carriage and thus the drive element (14), is adjusted to a position such that the articles (1a,1b,1c) are each engaged by the drive element (14) when they are conveyed to the work station (11), with the work tool (10) in an appropriate position to perform the work operation.

FIG 1



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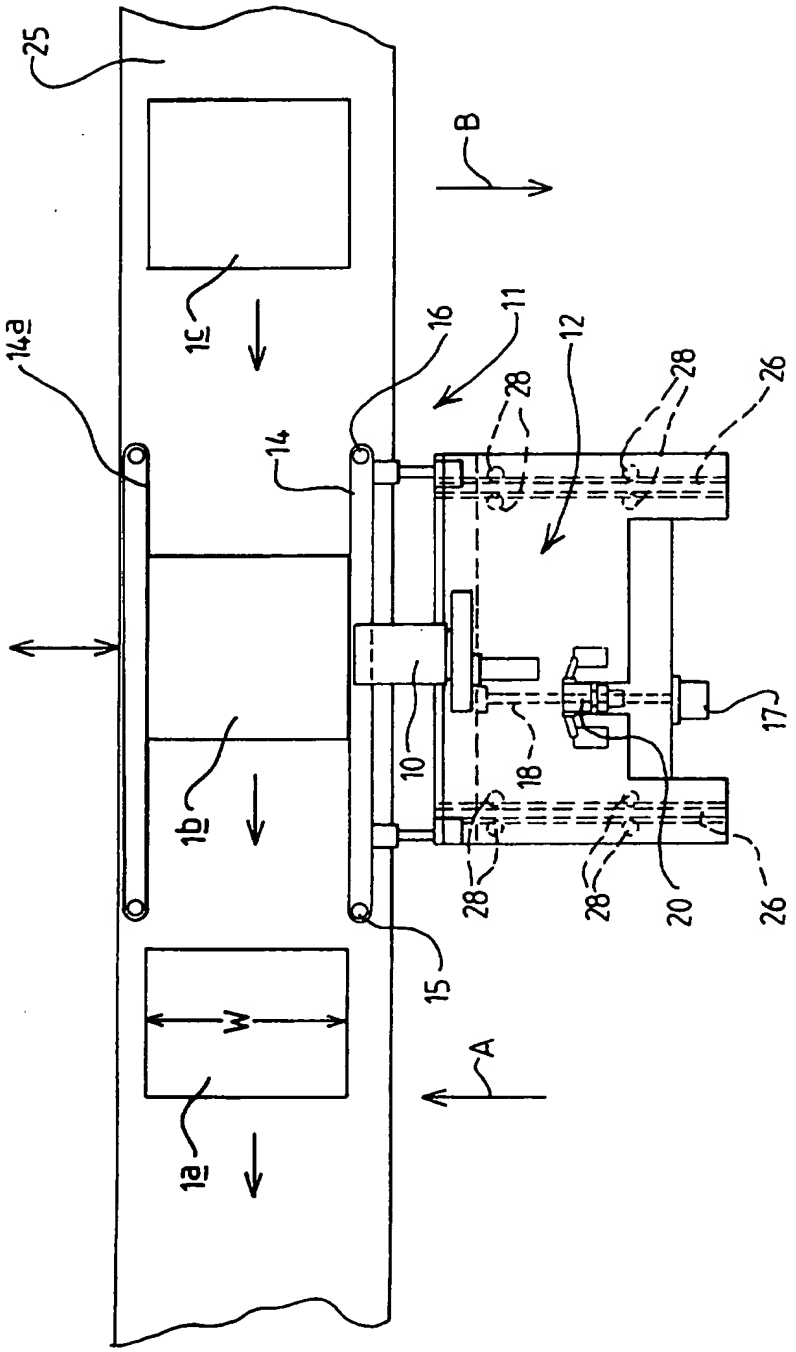

FIG 1

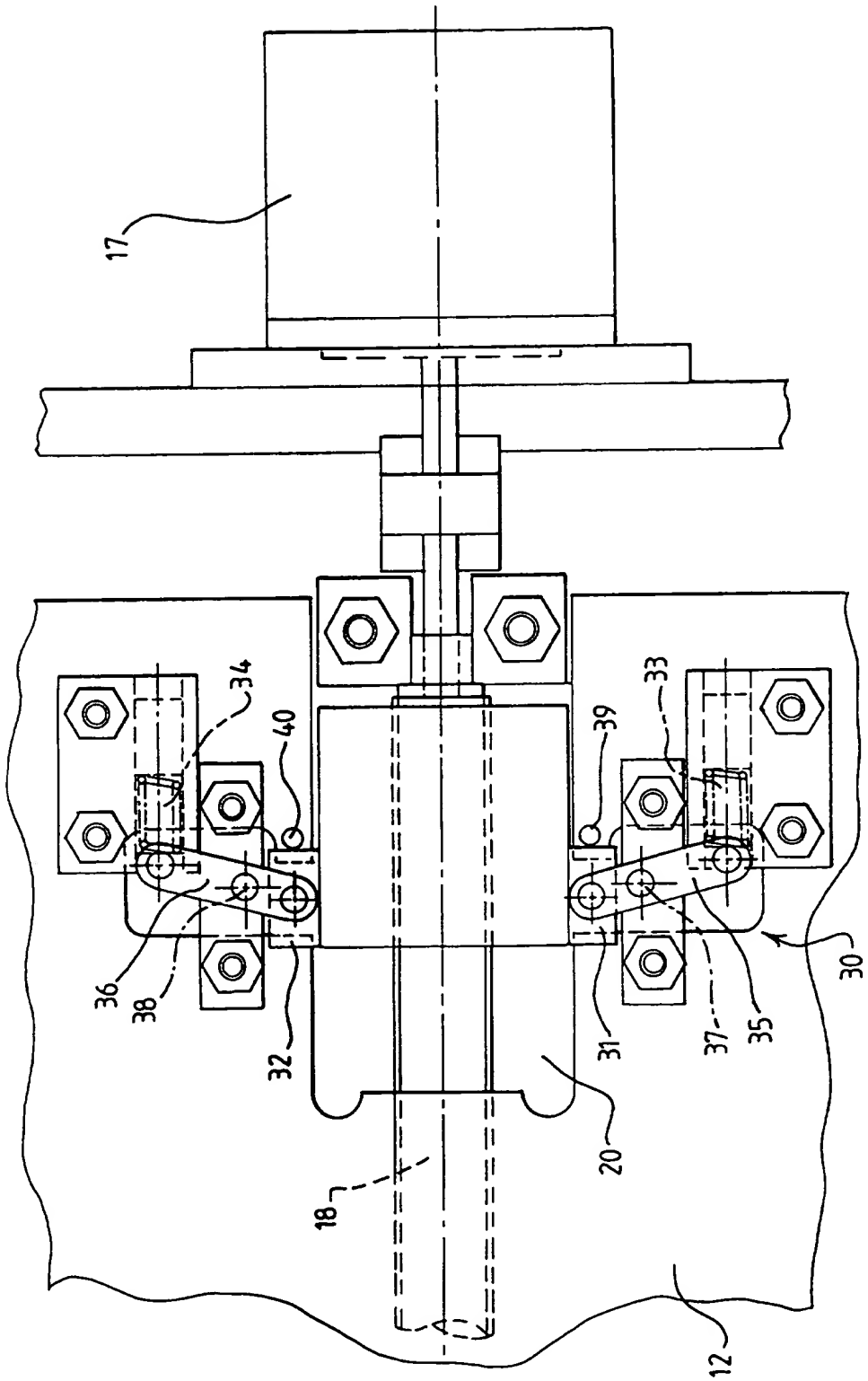

FIG 2

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Title: Method of Aligning a Work Tool Relative to an Article being Conveyed

Description of Invention

This invention relates to a method of aligning a work tool relative to an article being conveyed and more particularly but not exclusively to such a method for aligning a print head relative to an article which is being conveyed and on which it is desired to print information.

The invention has been particularly but not exclusively developed for use in a packaging line in which the articles comprise packages packaged upstream of the print head which are conveyed downstream on a conveyor. The information to be printed may for example comprise bar codes.

There are advantages in using a print head of the type which projects jets of marking medium such as ink onto the article in such an application but it is essential with such printers that the print head is positioned at an appropriate distance from the article for an image to be printed clearly. For example only, the optimum distance may be 1/8" depending on print head design.

However in a packaging line there may be considerable variance in the positioning of the articles across the conveyor, and the conveyor may be required to convey a batch of articles of one configuration followed by a batch of articles of a different configuration with a minimum interruption between batches. Furthermore the articles of any batch may have variations due to tolerances in the articles themselves.

Thus it is necessary to provide for some adjustment in either the position of the print head and/or in the positioning of the articles on the conveyor so that the print head may be appropriately positioned to achieve a clear image print.

It is preferred for the position of the articles on the conveyor to be interfered with as little as possible and so it is preferred for the position of the print head or other work tool to be adjustable.

According to a first aspect of the invention we provide a method of aligning a work tool relative to a succession of articles being conveyed, the method comprising providing the work tool at a work station on a carriage, which carriage is moveable fore and aft in a direction transverse to the conveying direction, the carriage comprising a drive element which is adapted to engage each of the articles when they are conveyed in succession to the work station while a work operation is performed on each of the articles by the tool, the method being characterised in that the carriage is movable transversely relative to the conveying direction by a motive means so that the position of the carriage and thus the drive element, is adjusted to a position such that the articles are each engaged by the drive element when they are conveyed to the work station, with the work tool in an appropriate position to perform the work operation.

Thus adjustment of the position of the drive element relative to the article is facilitated and may be automated to some degree.

In one example the position of the carriage may be adjusted by placing one of the articles (or a dummy article) at the work station and operating the drive means to move the carriage to bring the drive element towards the article until the drive element engages the article.

To ensure of adequate engagement between the drive element and all of the articles of the succession of articles, preferably the position of the drive element is further adjusted by moving the carriage so as to move the drive element a predetermined distance further in the same direction.

Although any suitable motive means might be used, particularly where the work tool is delicate, such as a print head of the type which projects a jet of

marking medium such as ink onto the article, the motive means may comprise a stepper motor. Also, such a motor is capable of very accurate control.

The motive means may further comprise a driven shaft which is threaded along at least part of its length and an oppositely threaded member in engagement with the thread of the shaft and mounted on the carriage so that as the shaft turns the threaded member moves along the shaft, and the carriage is moved fore or aft. Thus the rotational movement of the shaft is converted to linear movement of the carriage.

Preferably the threaded member is mounted on the carriage by a clutch mechanism which permits of differential movement between the threaded member and the carriage in the event that the carriage is forcibly moved, at least in one direction. Thus in the event of an article being conveyed to the work station which would otherwise not be able to be engaged by the drive element and moved by the drive element through the work station while work operations are carried out on the articles, such as for examples an oversize article or a misaligned article, the drive element will yield and thus allow such article to be aligned with the work tool.

In one arrangement the clutch mechanism may comprise at least one friction part, and means to urge the friction part into engagement with the threaded member. The means which urge the friction part into engagement with the threaded member may comprise a spring acting through a pivoted link.

However any other mechanical arrangement which permits the drive element to yield and thus accommodate an oversize and/or misaligned article could alternatively be provided.

Preferably the clutch mechanism provides a maximum force between the friction part and the threaded member to resist differential movement in response to carriage movement in the aft direction and a lesser force to resist differential movement in response to carriage movement in the fore direction.

Thus conveniently means may be provided to return the friction part to an original position from which it has been differentially moved by a movement of the carriage in the aft direction sufficient to overcome the frictional force, upon a subsequent carriage movement in the aft direction caused by motive means operation. Such return means may comprise for example only, a stop provided on the carriage.

According to a second aspect of the invention we provide an apparatus for aligning a work tool relative to a succession of articles being conveyed by the method of the first aspect of the invention.

Such an apparatus may comprise a pair of carriages each moveable in fore and aft directions together and apart, transverse to the conveying direction, each carriage comprising a drive element which is adapted to engage each of the articles when they are conveyed in succession to the work station while a work operation is performed on each of the articles by the tool, at least one of the carriages being movable transversely relative to the conveyor by a motive means so that the position of the carriage and thus the drive element, is adjusted to a position such that the articles are each engaged by the drive element when they are conveyed to the work station, with the work tool in an appropriate position to perform the work operation.

The invention will now be described with reference to the accompanying drawings in which:-

FIGURE 1 is an illustrative underside plan view of an apparatus for performing the method of the invention;

FIGURE 2 is a detailed enlarged view of a part of the apparatus of figure 1.

Referring to the drawings there is shown a work tool 10 which comprises in this example, a print head of the type which in response to a computer control, projects jets of marking medium such as ink onto an article 1a, 1b, 1c which may for example only, comprise packages packaged upstream

of the print head 10, which are conveyed downstream. The work tool 10 is located at a work station 11 and is mounted on a carriage 12 for movement in a direction transverse to the conveying direction, for and aft, i.e. towards and away from the article 1a, 1b, 1c being conveyed, as shown by the arrows A, B respectively.

The carriage 12 comprises a drive element 14. In this example, the drive element is a belt which is entrained about a pair of rollers 15, 16 and extends for substantially the entire length of the work station 11. At least one of the rollers 15, 16 is driven so that an article 1a, 1b, 1c engaging with the drive element 14 is moved by the drive element past the print head 10 whilst a printing operation may be carried out on the article 1a, 1b, 1c.

It can be seen that there is a second drive element indicated at 14a which may too be mounted on a carriage (not shown) which may be similar to, or different from the carriage 12 on which drive element 14 is carried.

The carriage 12 is moveable in its fore and aft directions A, B, by a motive means including a stepper motor 17 which is fixed relative to a frame on which the carriage 12 is mounted, the stepper motor 17 having a threaded output shaft 18 which is engaged an oppositely threaded member 20 so that as the output shaft 18 of the stepper motor 17 rotates, the threaded member 20 moves along the output shaft 18. The threaded member 20 is mounted on the carriage 12 as described in more detail below.

The positions of the drive elements 14 and 14a are set for a batch of articles 1a, 1b, 1c which are to be conveyed to the work station 11. In this example, the articles 1a, 1b and 1c are conveyed on a conveyor belt 25 but may alternatively may be conveyed on rollers, or by any other type of conveyor. It will be appreciated that the articles 1a, 1b, 1c may not be regularly spaced as shown, and may be not of a regular alignment across the conveyor belt 25. Also, the articles 1a, 1b, 1c are not all necessarily of constant dimension in that their widths i.e. the dimension indicated at W for article 1a, can vary in a batch.

The positions of the drive elements 14 and 14a are set up for a batch of articles as follows.

The largest perceived article of the batch, or a dummy article having a dimension W of the maximum size envisaged for the articles of the batch, is placed at the work station between the drive elements 14 and 14a which are spaced apart further than shown in Figure 1, the articles being positioned across the conveyor in the position which the articles of the batch are expected to occupy. For example, the article may be the first article of the batch conveyed to the work station 11 by the conveyor 25.

The drive element 14 at least, and preferably drive element 14a too is then moved in the fore direction A towards the article at the work station 11, by means of the motive means comprising the stepper motor 17, output shaft 18, and threaded member 20. When the drive elements 14 (and 14a too if driven) engages the article at the work station 11, the elements 14, 14a are then moved relatively towards one another a further predetermined distance.

For example, it may be that the articles 1a, 1b, 1c have a nominal tolerance of up to 6 mm in dimension W. The elements 14, 14a may thus each be moved closer towards one another say 3 mm to ensure that the drive elements 14, 14a positively engage even the smallest article of the batch of articles. Thus the position of the drive elements 14 is thus set for the batch of articles subsequently to be conveyed in succession to the work station 11.

The carriage 12 comprises a pair of guide rails 26 which slide in guide rollers 28 during movement of the carriage so that movement of the carriage 12 is maintained in a linear direction. The rollers 28 are preferably fixed with respect to a frame of the apparatus on which the carriage 12 is mounted.

Referring now particularly to the figure 2, in the event that an oversize article i.e. an article having a dimension W greater than the distance between the drive elements 14 and 14a, or in the event of an article being misaligned along the conveyor 25, conventionally, this could result in a jam at the work

station 11. In the present example, the threaded member 20 which is carried on the threaded output shaft 18 of the stepper motor 17 is mounted on the carriage 12 by means of the clutch mechanism indicated at 30. The clutch mechanism 30 permits of differential movement of the carriage 12 in the aft direction B away from the article, from the set position, if sufficient force is exerted to overcome a frictional force exerted by the clutch mechanism.

The clutch mechanism 30 comprises a pair of friction parts 31 and 32, each of which engages the threaded member 20 on an opposite surface thereof. The friction parts 31 and 32 are urged into engagement with the threaded member 20 by means of respective springs 33 and 34 acting through respective pivoting links 35, 36. Each link 35, 36 is pivoted about a pivot 37, 38 which is positioned so that the clutch mechanism 30 provides a maximum force between the friction parts 31 and 32 and the threaded member 20 to resist differential movement in response to carriage movement in the aft direction B, but a lesser force is exerted to resist differential movement in response to carriage 12 movement in the fore direction A. In figure 2, the threaded member 20 is shown in its aftmost position in which the drive element 14 will be spaced outwardly of any article on the conveyor 25.

When the threaded member 20 is returned to the position shown in figure 2 after differential movement between the friction parts 31, 32 and the threaded member 20 has occurred, as a result of forcible carriage movement in the aft direction B, each friction part 31, may engage with a respective reset pin 39 and 40 which is mounted on the carriage 12 so as to return the friction parts 31 and 32 to an initial position. Thus in the event that differential movement occurs the next time that the drive element 14 is moved in the aft direction B, the friction parts 31 and 32 will be returned to their original positions along threaded member 20. Thus the friction parts 31, 32 do not migrate along the threaded member 20 upon repeated differential movement occurring.

In any event, the threaded member 20 is sufficiently long that there is no risk of the friction part 31, 32 being moved by any article of the batch so far along the threaded member that disengagement between the friction parts and the threaded member 20 is likely to occur.

The force of the springs 33, 34 may be adjusted to provide a pre-determined resistance to movement of the friction parts 31, 32 on the threaded member 20.

Various modifications are possible without departing from the scope of the invention. For example, if desired, only drive element 14 may be moveable towards and away from the articles 1a, 1b, 1c, with there being some means provided to guide the articles 1a, 1b, 1c on the conveyor 25 at the opposite side of the conveyor to drive element 14.

An alternative kind of drive element 14 may be provided at work station 11 to the belt drive element 14 described.

Any alternative kind of clutch mechanism 30 for permitting differential movement of carriage 12 from its initial set positions may be provided as an alternative to that described. Particularly, some means of urging friction parts 31, 32 into engagement with a threaded member alternative to the springs 33, 34 may instead by provided.

Although in this example, the threaded member 20 is a female threaded member which is received on a male threaded output shaft 18 of the stepper motor 17, an alternative arrangement may be provided, or there may be provided gearing or the like to convert the rotary movement of the output shaft 18 of the motor 17 into a linear movement of the carriage 12.

A stepper motor 17 is preferred where the work tool 10 is of a delicate nature such as the print head 10 described. However an alternative kind of motor 17 or other inotive means may be provided if desired.

It will be appreciated that virtue of the present invention, regardless of the speed of the articles being conveyed on the conveyor 25, when the articles

1a, 1b, 1c reach the work station 11, their speed and alignment relative to the work tool 10 is controlled by means independent of the conveyor 25 so that the work operation may properly be carried out on the article. Particularly, where the work tool 10 is a print head of the kind described, the speed at which the articles 1a, 1b, 1c are moved past the work tool 10 is important in order to obtain prints of satisfactory quality. The present invention enables this to be achieved for a batch of articles with minimal risk of any article of the batches jamming at the work station 11 and with minimal interference of the position of the article 1a, 1b, 1c transversely of the conveyor 25, which could be detrimental to further work operations to be carried out on the articles downstream of the work station 11. As the speed at which the articles 1a,1b, 1c are moved through the work station 11 is controlled by the drive speed of the drive element 14, some differential movement of the articles 1a, 1b, 1c relative to the conveyor 25 in the direction of conveying, may occur.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A method of aligning a work tool relative to a succession of articles being conveyed, the method comprising providing the work tool at a work station on a carriage, which carriage is moveable fore and aft in a direction transverse to the conveying direction, the carriage comprising a drive element which is adapted to engage each of the articles when they are conveyed in succession to the work station while a work operation is performed on each of the articles by the tool, the method being characterised in that the carriage is movable transversely relative to the conveying direction by a motive means so that the position of the carriage and thus the drive element, is adjusted to a position such that the articles are each engaged by the drive element when they are conveyed to the work station, with the work tool in an appropriate position to perform the work operation.

2. A method according to claim 1 characterised in that the position of the carriage is adjusted by placing one of the articles at the work station and operating the drive means to move the carriage to bring the drive element towards the article until the drive element engages the article.

3. A method according to claim 2 characterised in that the position of the carriage is further adjusted by moving the carriage so as to move the drive element a predetermined distance further in the same direction.

4. A method according to any one of the preceding claims characterised in that the motive means comprises a stepper motor.

5. A method according to any one of the preceding claims characterised in that the motive means comprises a driven shaft which is threaded along at least

part of its length and an oppositely threaded member in engagement with the thread of the shaft and mounted on the carriage so that as the shaft turns the threaded member moves along the shaft, and the carriage is moved fore or aft.

6. A method according to claim 5 characterised in that the threaded member is mounted on the carriage by a clutch mechanism which permits of differential movement between the threaded member and the carriage in the event that the carriage is forcibly moved, at least in one direction.

7. A method according to claim 6 characterised in that the clutch mechanism comprises at least one friction part, and means to urge the friction part into engagement with the threaded member.

8. A method according to claim 7 characterised in that the means which urge the friction part into engagement with the threaded member comprises a spring acting through a pivoted link.

9. A method according to claim 7 or claim 8 characterised in that the clutch mechanism provides a maximum force between the friction part and the threaded member to resist differential movement in response to carriage movement in the aft direction and a lesser force to resist differential movement in response to carriage movement in the fore direction.

10. A method according to claim 9 characterised in that means are provided to return the friction part to an original position from which it has been differentially moved by a movement of the carriage in the aft direction sufficient to overcome the friction force, upon a subsequent carriage movement in the aft direction caused by motive means operation.

11. A method according to claim 10 characterised in that the means which return the friction part comprises a stop provided on the carriage.

12. A method according to any of the preceding claims characterised in that the drive element is driven to move the articles to the work station while work operations are performed on the articles.

13. A method of aligning a work tool relative to a succession of articles being conveyed, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

14. An apparatus for aligning a work tool relative to a succession of articles being conveyed by the method of any one of the preceding claims.

15. An apparatus according to claim 14 comprising a pair of carriages each moveable in fore and aft directions together and apart in directions transverse to the conveying direction, each carriage comprising a drive element which is adapted to engage each of the articles when they are conveyed in succession to the work station while a work operation is performed on each of the articles by the tool, at least one of the carriages being movable transversely relative to the conveyor by a motive means so that the position of the carriage and thus the drive element, is adjusted to a position such that the articles are each engaged by the drive element when they are conveyed to the work station, with the work tool in an appropriate position to perform the work operation.

16. An apparatus substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

17. Any novel feature of novel combination of features shown herein and/or shown in the accompanying drawings.

The Patent Office

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INVESTOR IN PEOPLE

Application No: GB 9806572.5
Claims searched: 1-16

Examiner: A J Rudge
Date of search: 19 February 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B6C(CBAD,CBAL,CEVS); B8R(RAJ11)

Int Cl (Ed.6): B41J-2/01;B41M-1/40;1/42;3/00;B65H-9/00

Other: Online -WPI,EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	US 4,478,142	(Santorineos) - eg Fig 6 & col.5, ll12-14	1 at least
Y	US 4,398,457	(Tokyo Shibaura) - eg col 8, ll 22 et seq	"
Y	US 4,182,239	(Timmins) - eg col 2, ll 27 et seq	"
X	US 4,080,896	(Kiwi) - eg claim 1	"
X	US 3,827,356	(Snow etc) - eg claim 1	"
X	US 3,765,326	(Filper) - see whole document	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.